

What is claimed is:

1. A monitor for monitoring presence or absence of a liquid product in a system for pumping said liquid product from a supply through a pump and associated tubing to a destination, comprising:

a capacitive sensor coupled to the outside of said tubing at a sensing location between said pump and said destination, said capacitive sensor being responsive to the presence or absence of said liquid product in said tubing;

said tubing having an inside surface at said sensing location and having a volume within said tubing at said sensing location, said tubing being selected from a material and having an inside diameter at said sensing location selected such that:

said material of said inside surface of said tubing and said inside diameter of said tubing being large enough such that said liquid product is substantially evacuated from said tubing at said sensing location when said liquid product is substantially absent from said tubing preceding said sensing location, and

said inside diameter of said tubing being small enough and said material of said inside surface being selected such that air remaining in said tubing is substantially absent from said tubing at said sensing location when said liquid product is substantially present in said supply;

said inside surface of said tubing and said liquid product being selected such that said liquid product forms a contact angle with said inside surface of said tubing at said sensing location of less than seventy degrees.
2. A monitor as in claim 1 wherein said tubing has longitudinal direction along a flow path of said liquid product and wherein said longitudinal direction of said tubing at said sensing location is other than horizontal.
3. A monitor as in claim 2 wherein said longitudinal direction of said destination tubing at said sensing location is substantially vertical.
4. A monitor as in claim 1 wherein bunching of said product in said tubing is not less than one half inch (12.7 millimeters) when said liquid product is substantially absent from said tubing preceding said sensing location.

5. A monitor as in claim 1 wherein air forms less than twenty-five percent of said volume in said tubing at said sensing location when said liquid product is substantially present in said tubing preceding said sensing location.
6. A monitor as in claim 1 wherein said inside surface of said tubing at said sensing location is polytetrafluoroethylene.
7. A monitor as in claim 1 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing following said sensing location.
8. A monitor as in claim 1 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing preceding said sensing location.
9. A monitor for monitoring presence or absence of a liquid product in a system for pumping said liquid product from a supply to a destination, comprising:
 - a pump;
 - associated tubing coupled between said supply and said pump and between said pump and said destination; and
 - a capacitive sensor coupled to the outside of said tubing at a sensing location between said pump and said destination, said capacitive sensor being responsive to the presence or absence of said liquid product in said tubing;said tubing having an inside surface at said sensing location and having a volume within said tubing at said sensing location, said tubing being selected from a material and having an inside diameter at said sensing location selected such that:
 - said material of said inside surface of said tubing and said inside diameter of said tubing being large enough such that said liquid product is substantially evacuated from said tubing at said sensing location when said liquid product is substantially absent from said tubing preceding said sensing location, and
 - said inside diameter of said tubing being small enough and said material of said inside surface being selected such that air remaining in said tubing is

substantially absent from said tubing at said sensing location when said liquid product is substantially present in said supply;

said inside surface of said tubing and said liquid product being selected such that said liquid product forms a contact angle with said inside surface of said tubing at said sensing location of less than seventy degrees.

10. A monitor as in claim 9 wherein said tubing has longitudinal direction and wherein said destination tubing at said sensing location is other than horizontal.
11. A monitor as in claim 10 wherein said longitudinal direction of said destination tubing at said sensing location is substantially vertical.
12. A monitor as in claim 9 wherein bunching of said product in said tubing is not less than one half inch (12.7 millimeters) when said liquid product is substantially absent from said tubing preceding said sensing location.
13. A monitor as in claim 9 wherein air forms less than twenty-five percent of said volume in said tubing at said sensing location when said liquid product is substantially present in said tubing preceding said sensing location.
14. A monitor as in claim 9 wherein said inside surface of said tubing at said sensing location is polytetrafluoroethylene.
15. A monitor as in claim 9 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing following said sensing location.
16. A monitor as in claim 9 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing preceding said sensing location.
17. A method of monitoring presence or absence of a liquid product in a system for pumping said liquid product from a supply through a pump and associated tubing to a destination, said tubing having an inside surface at a sensing location and having a volume within said tubing at said sensing location, comprising:

selecting said inside surface of said tubing from a material, selecting an inside diameter of said tubing and selecting said liquid product such that:

said liquid product forms a contact angle with said inside surface of said tubing at said sensing location of less than seventy degrees;

said material of said inside surface of said tubing and said inside diameter of said tubing being large enough such that said liquid product is substantially evacuated from said tubing at said sensing location when said liquid product is substantially absent from said tubing preceding said sensing location, and

said inside diameter of said tubing being small enough and said material of said inside surface being selected such that air remaining in said tubing is substantially absent from said tubing at said sensing location when said liquid product is substantially present in said supply; and

coupling a capacitive sensor to the outside of said tubing at said sensing location between said pump and said destination, said capacitive sensor being responsive to the presence or absence of said liquid product in said tubing.

18. A method of monitoring as in claim 17 wherein said tubing has longitudinal direction and wherein said longitudinal direction of said tubing at said sensing location is other than horizontal.
19. A method of monitoring as in claim 18 wherein said longitudinal direction of said destination tubing at said sensing location is substantially vertical.
20. A method of monitoring as in claim 17 wherein bunching of said product in said tubing is not less than one half inch (12.7 millimeters) when said liquid product is substantially absent from said tubing preceding said sensing location.
21. A method of monitoring as in claim 17 wherein air forms less than twenty-five percent of said volume in said tubing at said sensing location when said liquid product is substantially present in said tubing preceding said sensing location.
22. A method of monitoring as in claim 17 wherein said inside surface of said tubing at said sensing location is polytetrafluoroethylene.

23. A method of monitoring as in claim 17 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing following said sensing location.
24. A method of monitoring as in claim 17 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing preceding said sensing location.
25. A monitor for monitoring presence or absence of a liquid product in a system for pumping said liquid product from a supply through a pump and associated tubing to a destination, comprising:
- a capacitive sensor coupled to the outside of said tubing at a sensing location between said supply and said pump, said capacitive sensor being responsive to the presence or absence of said liquid product in said tubing;
- said tubing having an inside surface and a volume within said tubing at said sensing location, said tubing being selected from a material and having an inside diameter at said sensing location selected such that:
- said material of said inside surface of said tubing and said inside diameter of said tubing being large enough such that said liquid product substantially drains from said tubing at said sensing location when said liquid product is substantially absent from said tubing preceding said sensing location, and
- said inside diameter of said tubing being small enough and said material of said inside surface being selected such that said liquid product is substantially evacuated by pumping from said tubing at said sensing location when said liquid product is substantially absent from said tubing preceding said sensing location;
- said inside surface of said tubing and said liquid product being selected such that said liquid product forms a contact angle with said inside surface of said tubing at said sensing location of less than seventy degrees.

26. A monitor as in claim 25 wherein said tubing has longitudinal direction along a flow path of said liquid product and wherein said longitudinal direction of said tubing at said sensing location is other than horizontal.
27. A monitor as in claim 26 wherein said longitudinal direction of said destination tubing at said sensing location is substantially vertical.
28. A monitor as in claim 25 wherein bunching of said product in said tubing is not less than one half inch (12.7 millimeters) when said liquid product is substantially absent from said tubing preceding said sensing location.
29. A monitor as in claim 25 wherein air forms at least seventy-five percent of said volume inside of said tubing at said sensing location when said liquid product is substantially absent from said tubing preceding said sensing location.
30. A monitor as in claim 25 wherein said inside surface of said tubing at said sensing location is polytetrafluoroethylene.
31. A monitor as in claim 25 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing following said sensing location.
32. A monitor as in claim 25 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing preceding said sensing location.
33. A monitor for monitoring presence or absence of a liquid product in a system for pumping said liquid product from a supply to a destination, comprising:
a pump;
associated tubing coupled between said supply and said pump and between said pump and said destination; and
a capacitive sensor coupled to the outside of said tubing at a sensing location between said pump and said destination, said capacitive sensor being responsive to the presence or absence of said liquid product in said tubing;

said tubing having an inside surface and a volume within said tubing at said sensing location, said tubing being selected from a material and having an inside diameter at said sensing location selected such that:

said material of said inside surface of said tubing and said inside diameter of said tubing being large enough such that said liquid product substantially drains from said tubing at said sensing location when said liquid product is substantially absent from said tubing preceding said sensing location, and

said inside diameter of said tubing being small enough and said material of said inside surface being selected such that said liquid product is substantially evacuated by pumping from said tubing at said sensing location when said liquid product is substantially absent from said tubing preceding said sensing location;

said inside surface of said tubing and said liquid product being selected such that said liquid product forms a contact angle with said inside surface of said tubing at said sensing location of less than seventy degrees.

34. A monitor as in claim 33 wherein said tubing has longitudinal direction and wherein said destination tubing at said sensing location is other than horizontal.
35. A monitor as in claim 34 wherein said longitudinal direction of said destination tubing at said sensing location is substantially vertical.
36. A monitor as in claim 33 wherein bunching of said product in said tubing is not less than one half inch (12.7 millimeters) when said liquid product is substantially absent from said tubing preceding said sensing location.
37. A monitor as in claim 33 wherein air forms at least seventy-five percent of said volume inside of said tubing at said sensing location when said liquid product is substantially absent from said tubing preceding said sensing location.
38. A monitor as in claim 33 wherein said inside surface of said tubing at said sensing location is polytetrafluoroethylene.

39. A monitor as in claim 33 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing following said sensing location.
40. A monitor as in claim 33 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing preceding said sensing location.
41. A method of monitoring presence or absence of a liquid product in a system for pumping said liquid product from a supply through a pump and associated tubing to a destination, said tubing having an inside surface and a volume within said tubing at said sensing location, comprising:
- selecting an inside surface of said tubing from a material, selecting an inside diameter of said tubing and selecting said liquid product such that:
- said liquid product forms a contact angle with an inside surface of said tubing at said sensing location of less than seventy degrees;
- said material of said inside surface of said tubing and said inside diameter of said tubing being large enough such that said liquid product substantially drains from said tubing at said sensing location when said liquid product is substantially absent from said tubing preceding said sensing location, and
- said inside diameter of said tubing being small enough and said material of said inside surface being selected such that said liquid product is substantially evacuated by pumping from said tubing at said sensing location when said liquid product is substantially absent from said tubing preceding said sensing location; and
- coupling a capacitive sensor to the outside of said tubing between said pump and said destination, said capacitive sensor being responsive to the presence or absence of said liquid product in said tubing.
42. A method of monitoring as in claim 41 wherein said tubing has longitudinal direction and wherein said longitudinal direction of said tubing at said sensing location is other than horizontal.

43. A method of monitoring as in claim 42 wherein said longitudinal direction of said destination tubing at said sensing location is substantially vertical.
44. A method of monitoring as in claim 41 wherein bunching of said product in said tubing is not less than one half inch (12.7 millimeters) when said liquid product is substantially absent from said tubing preceding said sensing location.
45. A method of monitoring as in claim 41 wherein air forms at least seventy-five percent of said volume inside of said tubing at said sensing location when said liquid product is substantially absent from said tubing preceding said sensing location.
46. A method of monitoring as in claim 41 wherein said inside surface of said tubing at said sensing location is polytetrafluoroethylene.
47. A method of monitoring as in claim 41 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing following said sensing location.
48. A method of monitoring as in claim 41 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing preceding said sensing location.
49. A monitor for monitoring flow of a liquid product at a sensing location in a system for pumping said liquid product through tubing in a flow direction with said sensing location having an inlet and an outlet, said tubing having an outside and an inside surface, comprising:

a capacitive sensor coupled to said outside surface of said tubing at said sensing location, said capacitive sensor being responsive to presence or absence of said liquid product in said tubing;

said tubing having a longitudinal direction along a flow path of said liquid product, said longitudinal direction of said tubing at said sensing location being other than horizontal with said outlet being vertically lower than said inlet;

said tubing being selected from a material and having an inside diameter at said sensing location selected such that:

said inside diameter of said tubing at said sensing location being small enough that said liquid product flowing through said tubing at said sensing location can be sensed by said capacitive sensor; and

said inside diameter of said tubing at said sensing location being large enough that said liquid product in said tubing substantially drains from said tubing at said sensing location when said liquid product is not flowing through said tubing at said sensing location; and

said material of said inside surface of said tubing and said inside diameter of said tubing being large enough so that air substantially remains in said tubing at said sensing location when said liquid product is flowing through said tubing at said sensing location.

50. A monitor as in claim 49 wherein said longitudinal direction of said tubing at said sensing location is between horizontal and vertical and wherein said capacitive sensor is coupled on the underside of said tubing at said sensing location.
51. A monitor as in claim 50 wherein said longitudinal direction of said tubing at said sensing location is between one degree and fifteen degrees of vertical.
52. A monitor as in claim 49 wherein said inside surface of said tubing at said sensing location is polytetrafluoroethylene.
53. A monitor as in claim 49 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing following said sensing location.
54. A monitor as in claim 49 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing preceding said sensing location.
55. A monitor as in claim 49 wherein said system pump said liquid product from a supply through a pump to a destination and wherein said sensing location is located between said pump and said destination.
56. A monitor for monitoring flow of a liquid product in a system for pumping said liquid product in a flow direction, comprising:

a pump;

tubing operatively coupled to said pump; and

a capacitive sensor coupled to the outside of said tubing at a sensing location having an inlet and an outlet, said capacitive sensor being responsive to the presence or absence of said liquid product in said tubing;

said tubing having a longitudinal direction along a flow path of said liquid product, said longitudinal direction of said tubing at said sensing location being other than horizontal with said outlet being vertically lower than said inlet;

said tubing having an inside surface at said sensing location, having a volume within said tubing at said sensing location, said tubing being selected from a material and having an inside diameter at said sensing location selected such that:

said inside diameter of said tubing at said sensing location being small enough that said liquid product flowing through said tubing at said sensing location can be sensed by said capacitive sensor; and

said inside diameter of said tubing at said sensing location being large enough that said liquid product in said tubing substantially drains from said tubing at said sensing location when said liquid product is not flowing through said tubing at said sensing location; and

said material of said inside surface of said tubing and said inside diameter of said tubing being large enough so that air substantially remains in said tubing at said sensing location when said liquid product is flowing through said tubing at said sensing location.

57. A monitor as in claim 56 wherein said longitudinal direction of said tubing at said sensing location is between horizontal and vertical and wherein said capacitive sensor is coupled on the underside of said tubing at said sensing location.
58. A monitor as in claim 57 wherein said longitudinal direction of said tubing at said sensing location is between one degree and fifteen degrees of vertical.
59. A monitor as in claim 56 wherein said inside surface of said tubing at said sensing location is polytetrafluoroethylene.

60. A monitor as in claim 56 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing following said sensing location.
61. A monitor as in claim 56 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing preceding said sensing location.
62. A method of monitoring flow of a liquid product at a sensing location having an inlet and an outlet in a system for pumping said liquid product through tubing with said tubing having a longitudinal direction along a flow path of said liquid product, said longitudinal direction of said tubing at said sensing location being other than horizontal with said outlet being vertically lower than said inlet, said tubing having an outside and an inside surface, comprising the steps of:
selecting said inside surface of said tubing from a material and selecting an inside diameter of said tubing such that:
said inside diameter of said tubing at said sensing location being small enough that said liquid product flowing through said tubing at said sensing location can be sensed by said capacitive sensor; and
said inside diameter of said tubing at said sensing location being large enough that said liquid product in said tubing substantially drains from said tubing at said sensing location when said liquid product is not flowing through said tubing at said sensing location; and
said material of said inside surface of said tubing and said inside diameter of said tubing being large enough so that air substantially remains in said tubing at said sensing location when said liquid product is flowing through said tubing at said sensing location; and
coupling a capacitive sensor to said outside surface of said tubing at said sensing location, said capacitive sensor being responsive to said flow of said liquid product in said tubing.
63. A method of monitoring as in claim 62 wherein said longitudinal direction of said tubing at said sensing location is between horizontal and vertical and wherein said

capacitive sensor is coupled on the underside of said tubing at said sensing location.

64. A method of monitoring as in claim 63 wherein said longitudinal direction of said tubing at said sensing location is between one degree and fifteen degrees of vertical.
65. A method of monitoring as in claim 62 wherein said inside surface of said tubing at said sensing location is polytetrafluoroethylene.
65. A method of monitoring as in claim 61 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing following said sensing location.
67. A method of monitoring as in claim 62 wherein said inside diameter of said tubing at said sensing location is larger than said inside diameter of said tubing preceding said sensing location.